Instrumental upgrades of the RIXS station at the ADRESS beamline of the Swiss Light Source

Thorsten Schmitt*[1], Leonard Nue[1], Vladimir Strocov[1], and Bernd Schmitt[1]

[1]Paul Scherrer Institut

The experimental development of the Resonant Inelastic X-ray Scattering (RIXS) technique in the soft X-ray energy range has been tremendous during the last years. RIXS instruments at synchrotron radiation sources have recently boosted the scientific capabilities with soft X-ray RIXS. The ADRESS beamline of the Swiss Light Source at the Paul Scherrer Institut and its RIXS spectrometer SAXES have increased the resolving power for the incident and the outgoing X-ray beam to above 10'000. Such an extremely high spectral resolution and the possibility to rotate the spectrometer to different scattering geometries allows for analysing the collective behavior of charge, orbital and spin excitations by assessing their momentum dependence. New RIXS instruments with increased energy resolution are currently in commissioning or on the way of being built at several synchrotron radiation facilities world-wide.

We report on recent upgrades of the spectrometer grating optics, with which the detection efficiency for the inelastically scattered X-rays has been increased by a factor 5, albeit maintaining the resolving power around 10'000. A new sample manipulator with 3 translational and 3 rotational degrees of freedom allows positioning samples with an accuracy of 5 μm and 0.05°, respectively. This manipulator minimizes the thermal drift upon varying the temperature between 10 K and 340 K to below 20 μm and avoids parasitic mechanical coupling between any of the rotations and translations. It will ease performing highly reproducible momentum dependent RIXS scans.

The total RIXS spectrometer resolution at the ADRESS beamline is currently heavily limited by the spatial resolution of the present CCD camera, contributing more than 50% to the total spectrometer energy resolution. A custom made Electron Multiplying (EM) CCD camera will allow improved signal to readout noise ratios making achievable a much faster read-out speed for reading a complete chip, which is prerequisite for employment of event centroiding algorithms with reasonable duty cycles. We have recently demonstrated that an effective spatial resolution of below 2 μm is possible in photon counting mode for such a CCD camera based on a commercially available chip. The camera will comprise of 3 horizontally clustered chips in order to also increase the signal strength correspondingly.

*Corresponding author: thorsten.schmitt@psi.ch